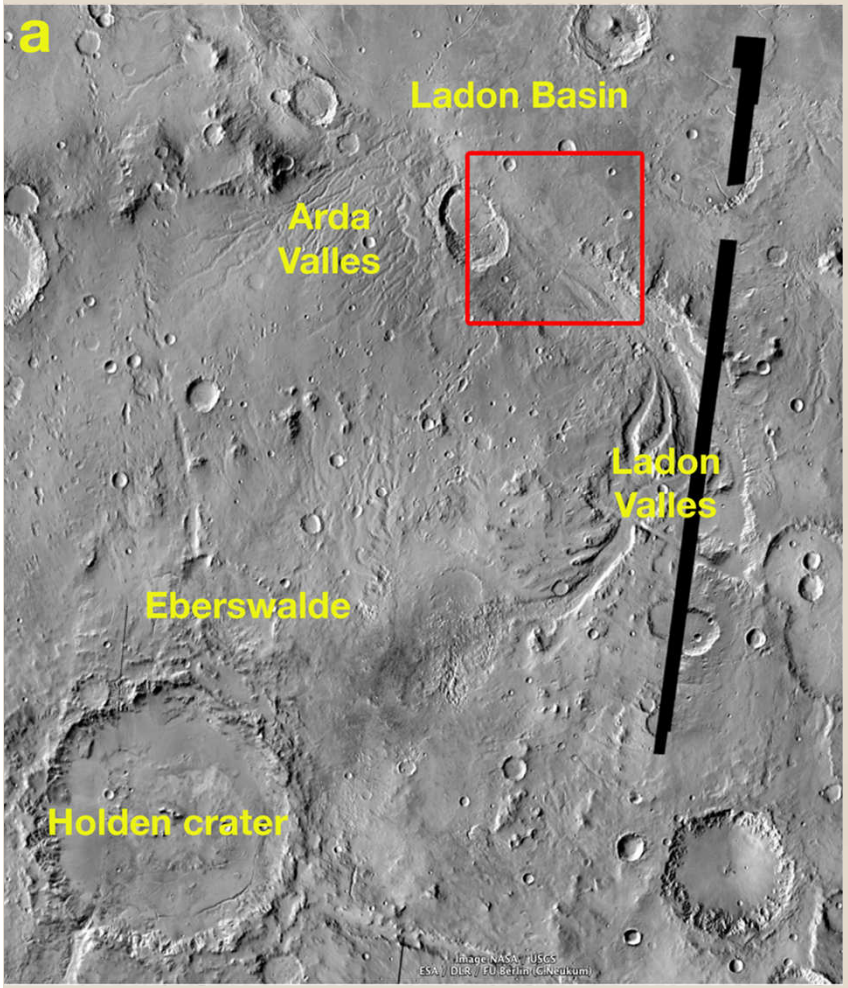
A Proposed Future Landing Site in Ladon Valles

Catherine Weitz and Janice Bishop

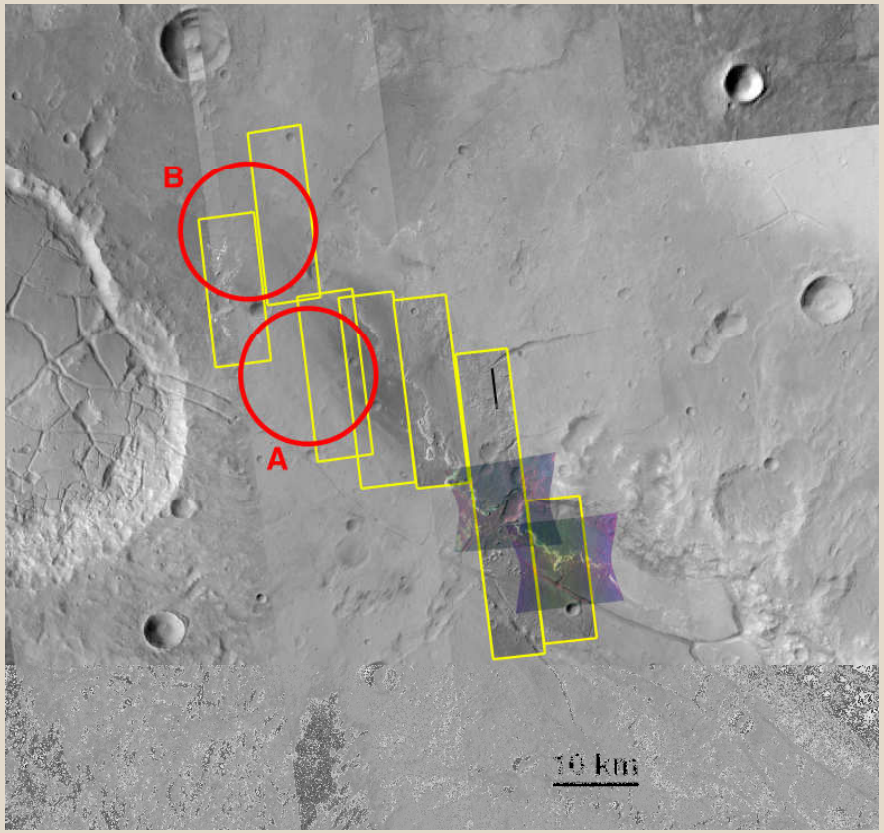
Geologic Background



- Ladon Valles is the middle segment in the Uzboi-Ladon-Morava system that formed in the Noachian. It connects Holden Basin to Ladon Basin.
- Ladon Basin is thought to preserve a record of fluvial and lacustrine sediments from the Noachian, including clays.
- Light-toned Layered Deposits (LLDs) are exposed along terraces at the distal end of Ladon Valles where the channel intersects Ladon basin.
- Fluvial sediments could represent initial infilling of the basin that were subsequently incised by later flooding through Ladon Valles.

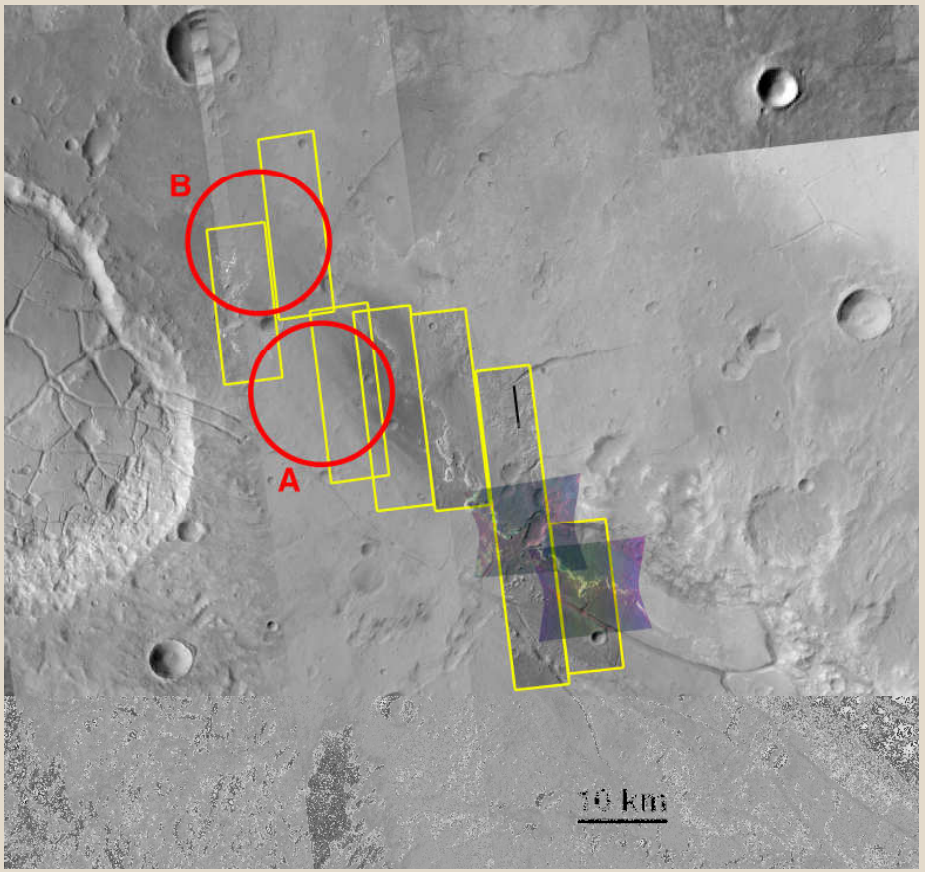
Selection of Landing Site Ellipses

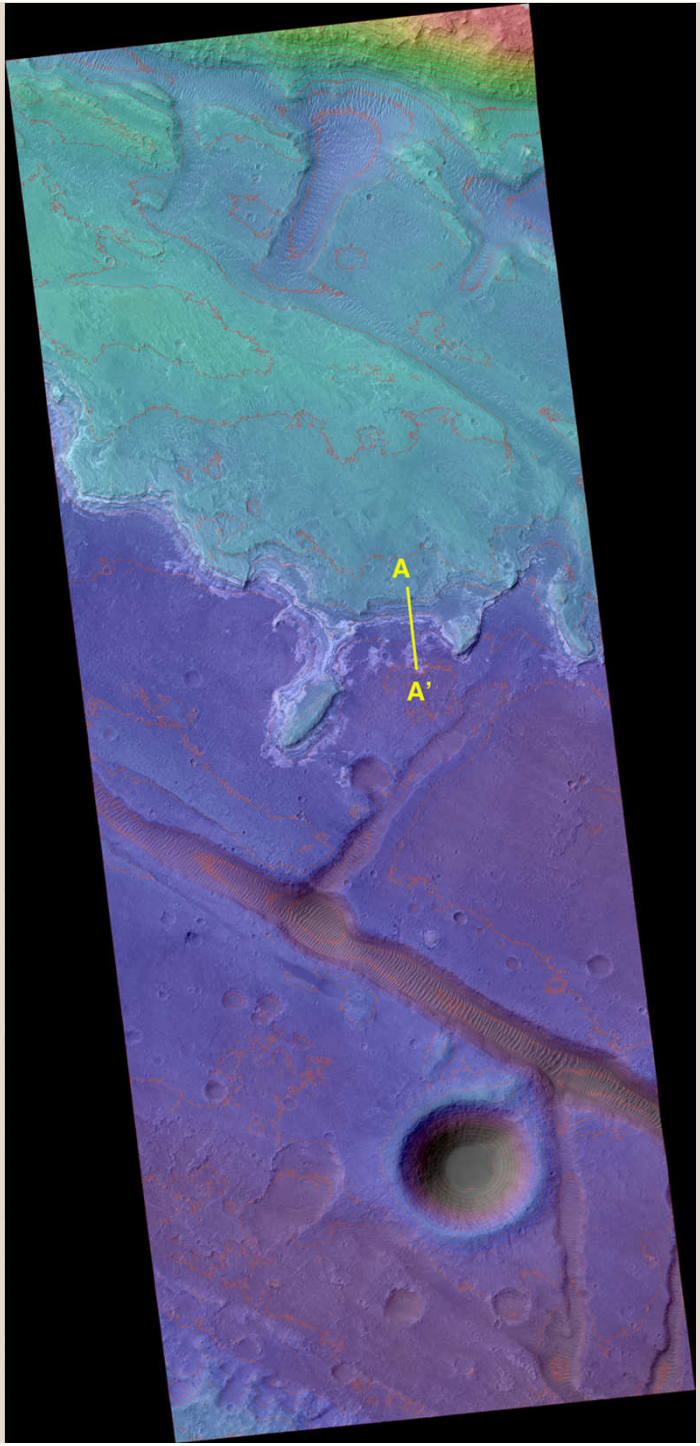
- Both landing ellipses were selected on relatively flat regions, although site A has several large craters where the crater walls could pose slope hazards.
- Ellipse A cannot be moved further south because of deep and wide fractures along Ladon Valles floor. The ellipse cannot be moved further east because of steep slopes along the LLDs, but could be moved further north and west, although this will move the rover futher away from the primary science targets located to the southeast.
- Ellipse B can be moved further north and west if needed for engineering constraints and is currently located directly on LLDs that would be easily accessible to a rover within the landing ellipse.



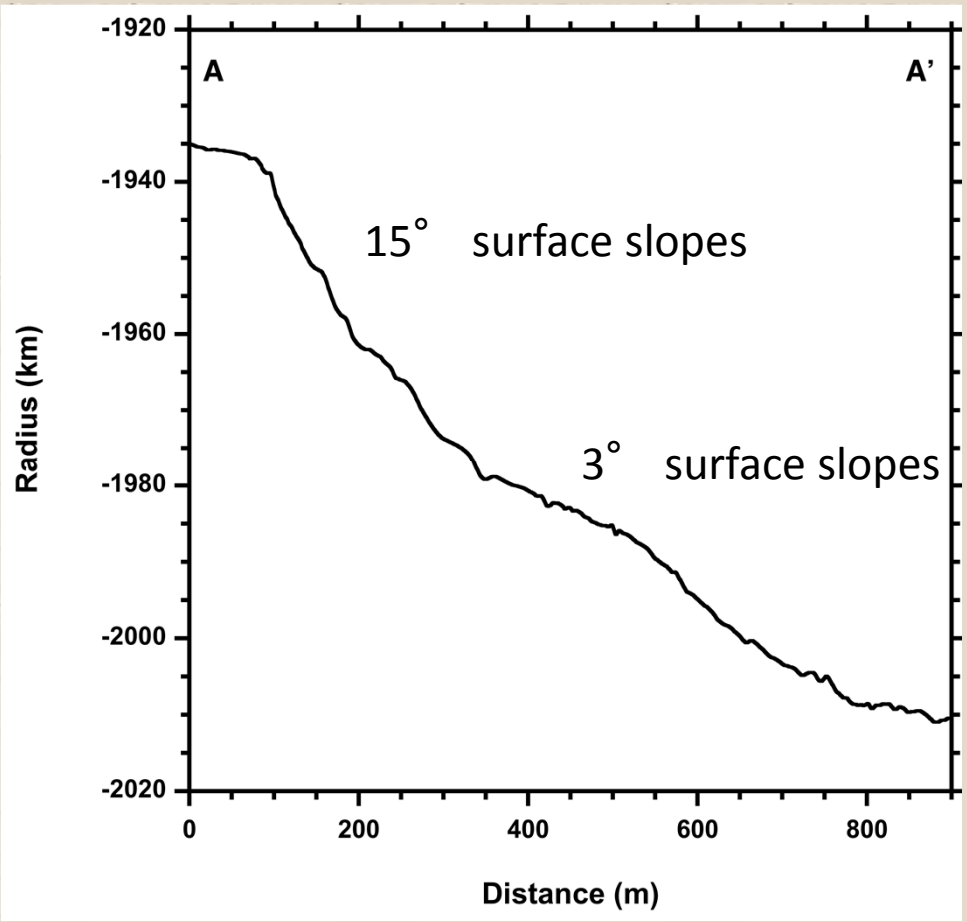
Ellipse Characteristics

Site Name	Ladon Valles
Center Coordinates Latitude, longitude	A ellipse: 329.8°E, 20.5°S B ellipse: 329.7°E, 20.2°S
Elevation	-2.12 km wrt MOLA
Ellipse Size	15 km by 15 km
Prime Science Targets	Smectites, Layered Sediments [Highest Priority], Dehydrated materials [Lower Priority]
Distance of Science Targets from Ellipse Center	*Ellipse A:* Smectites, dehydrated materials, layered sediments – 7 km to E *Ellipse B*: Layered sediments – 1.5 km to the SW

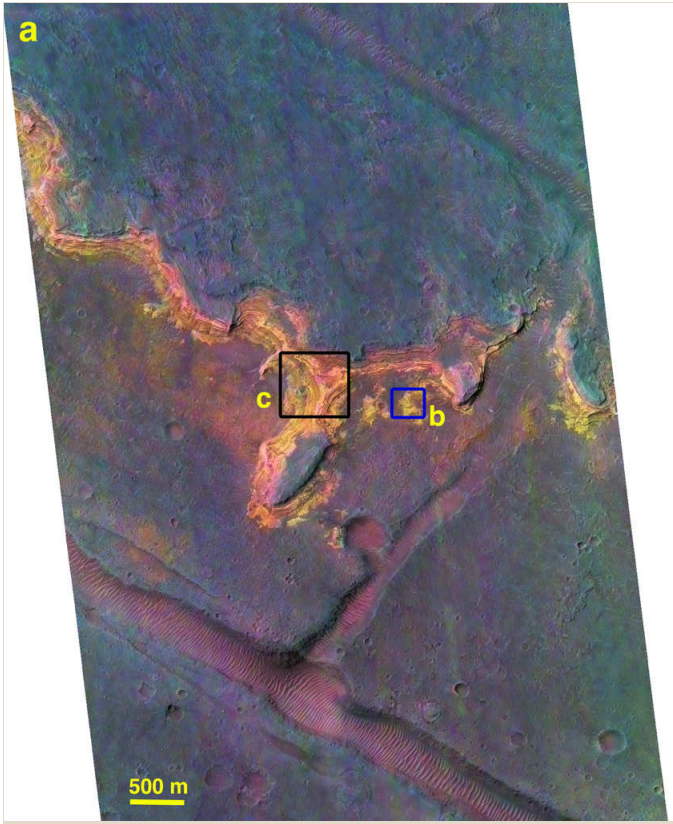


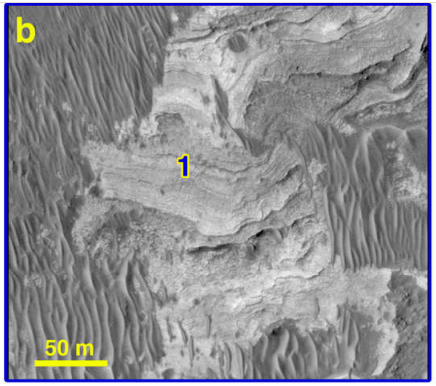


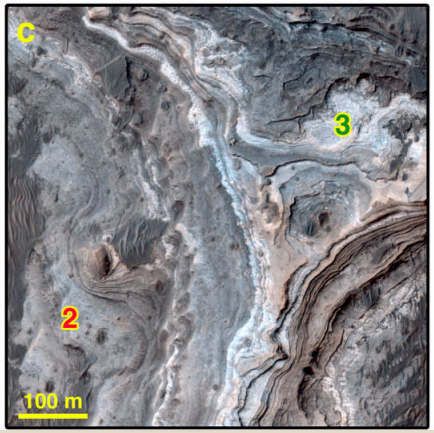
HiRISE DEM and topography profile

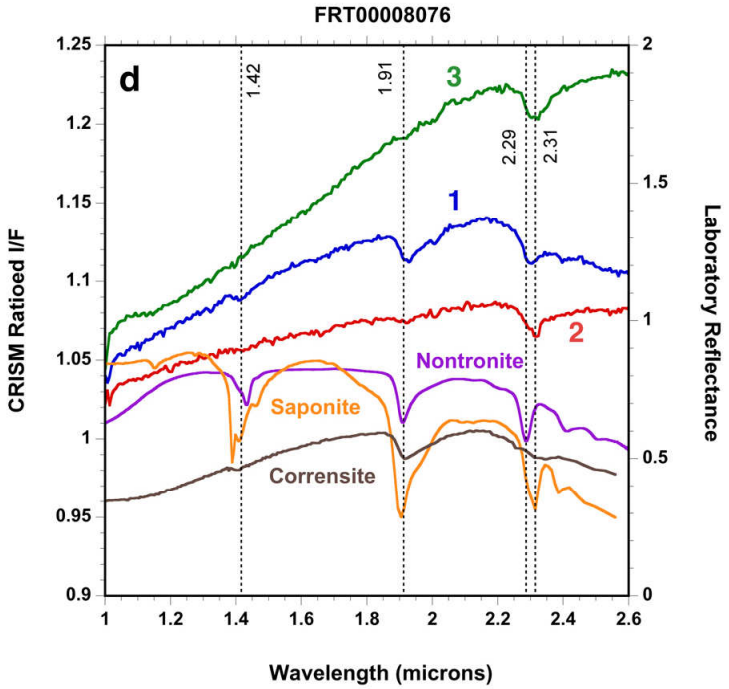


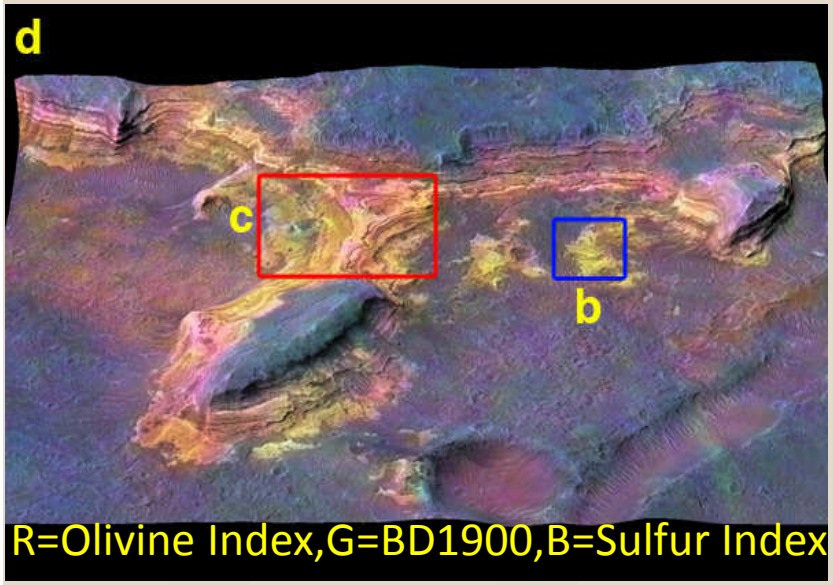
- 55 m thick sequence of exposed layered beds
- All beds are less than ~5 meters thick
- Beds appear nearly horizontal as they can be traced across the same elevation for several kms.









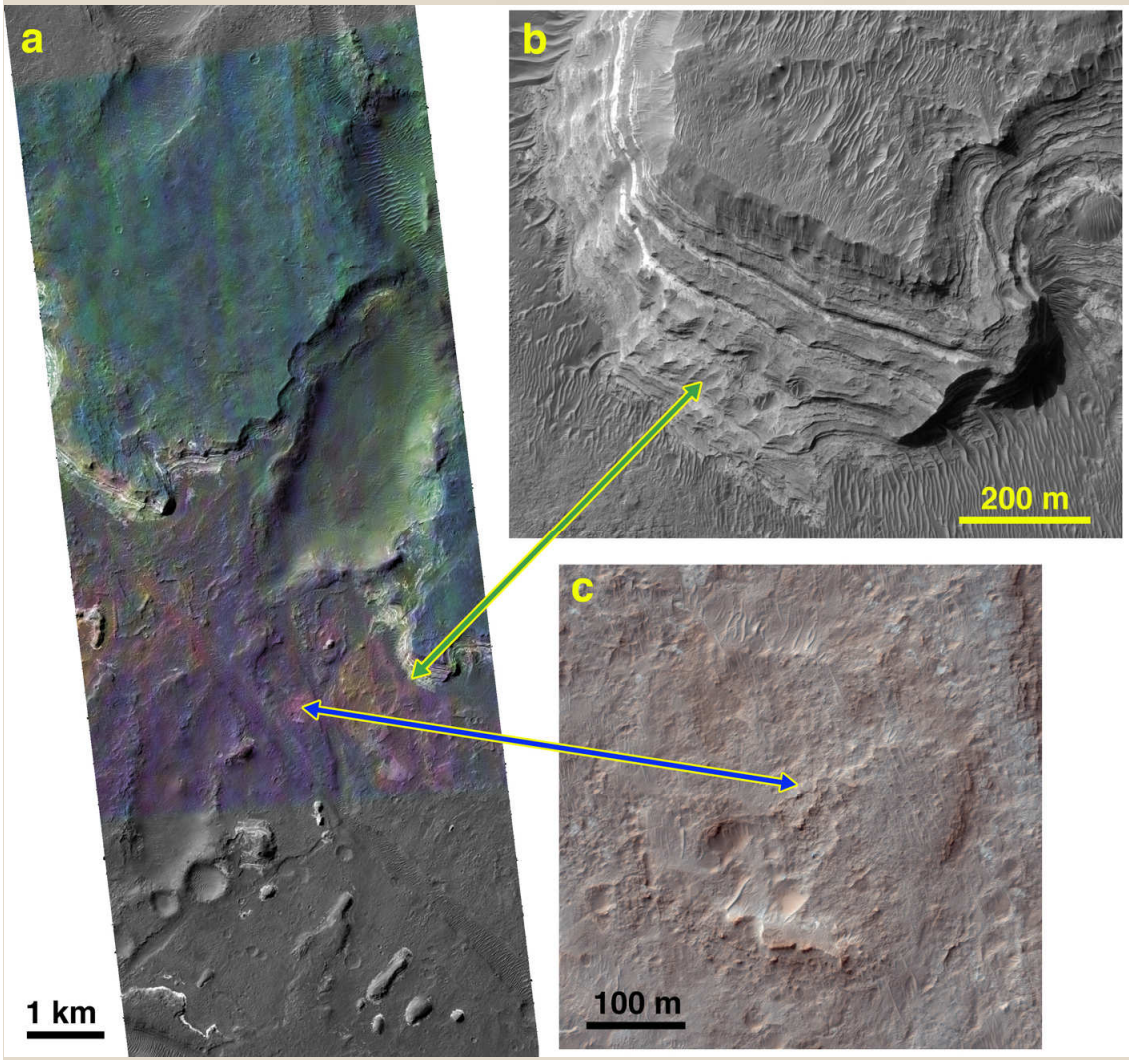


(b) Light-toned layered beds exposed near the lowest portion of the strata. CRISM spectrum (shown in blue,1) is consistent with Mg/Fe-smectites or Mg-rich mixed-layer smectite/chlorite (corrensite).

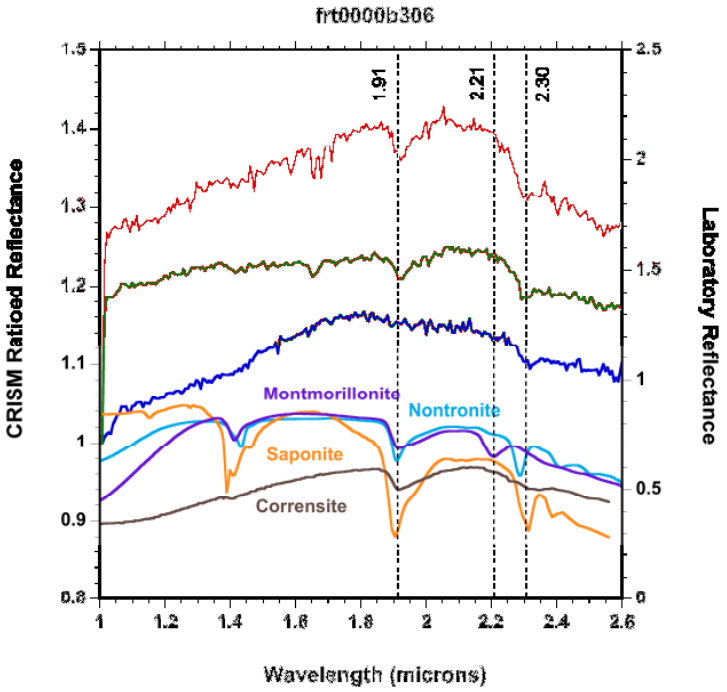
(c) Enhanced color image of layered beds near the upper portion of exposed strata. CRISM spectra (shown in red,2 and green,3) have strong absorption around 2.3 um but lack a hydration absorption around 1.9 um.

(d) DTM at 5x vertical exaggeration with CRISM parameters overlain in color.

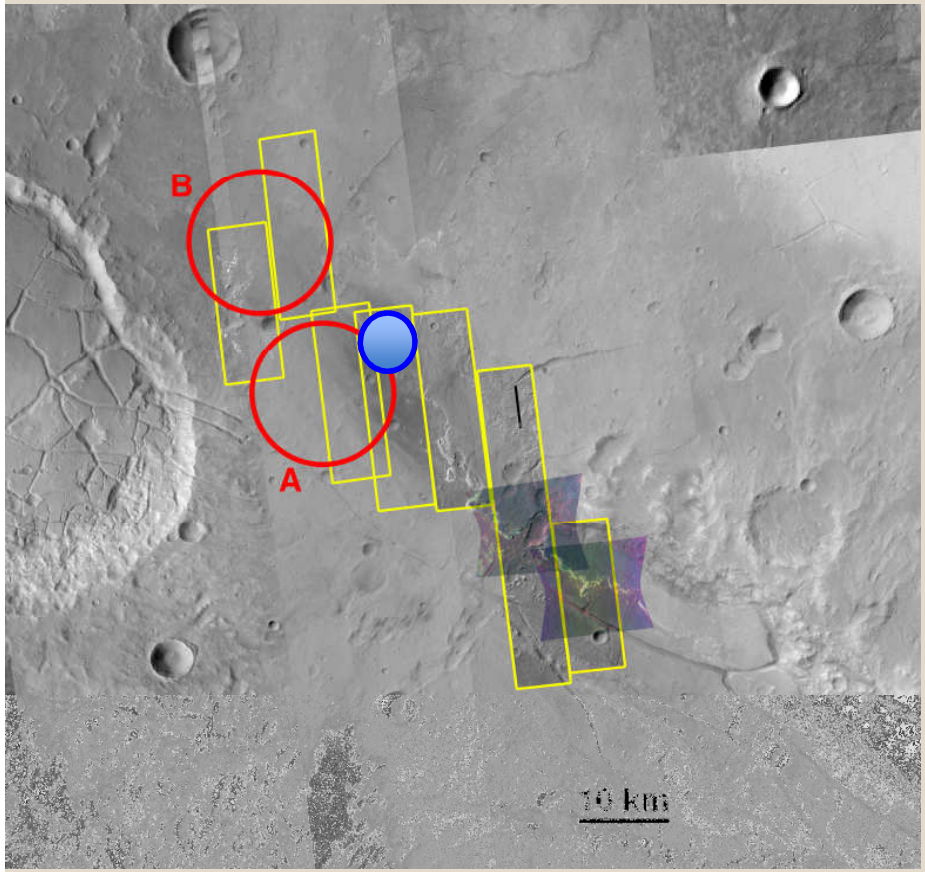
Moving westward towards landing ellipses

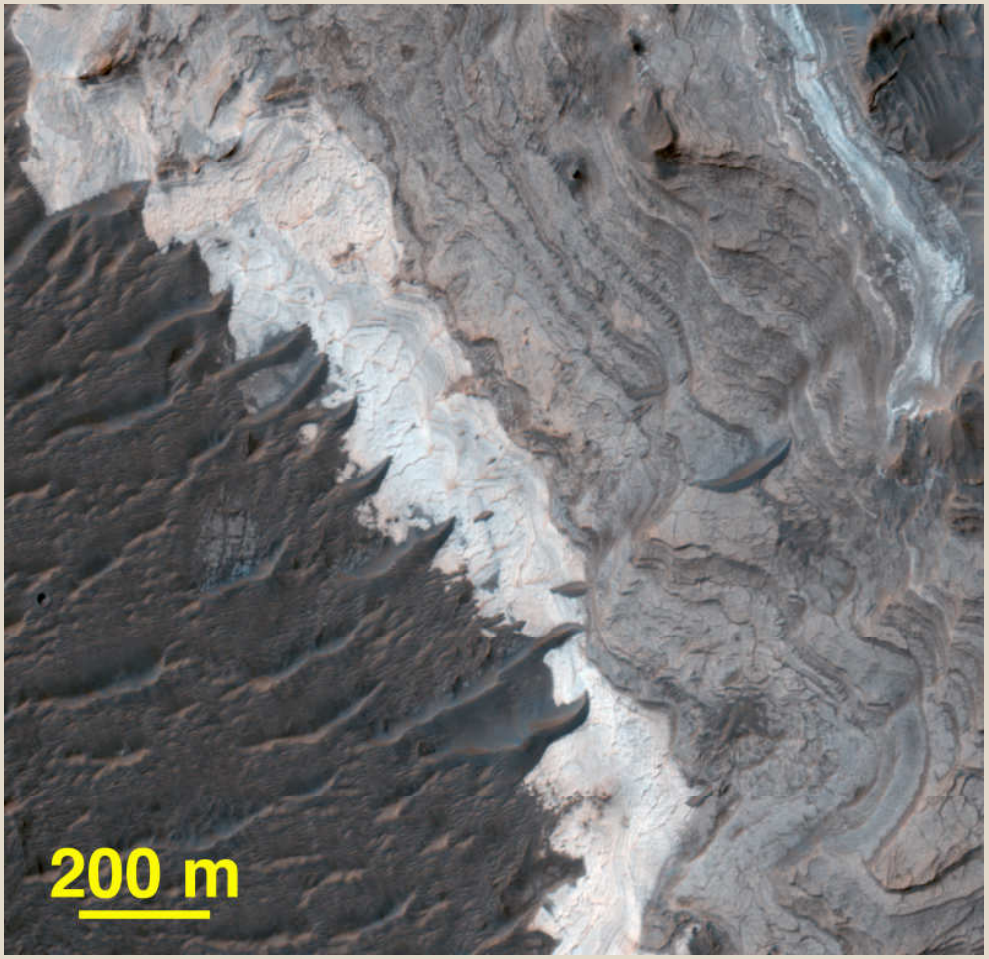


CRISM in color,
R=Olivine Index,
G=BD1900R,
B=BD2500



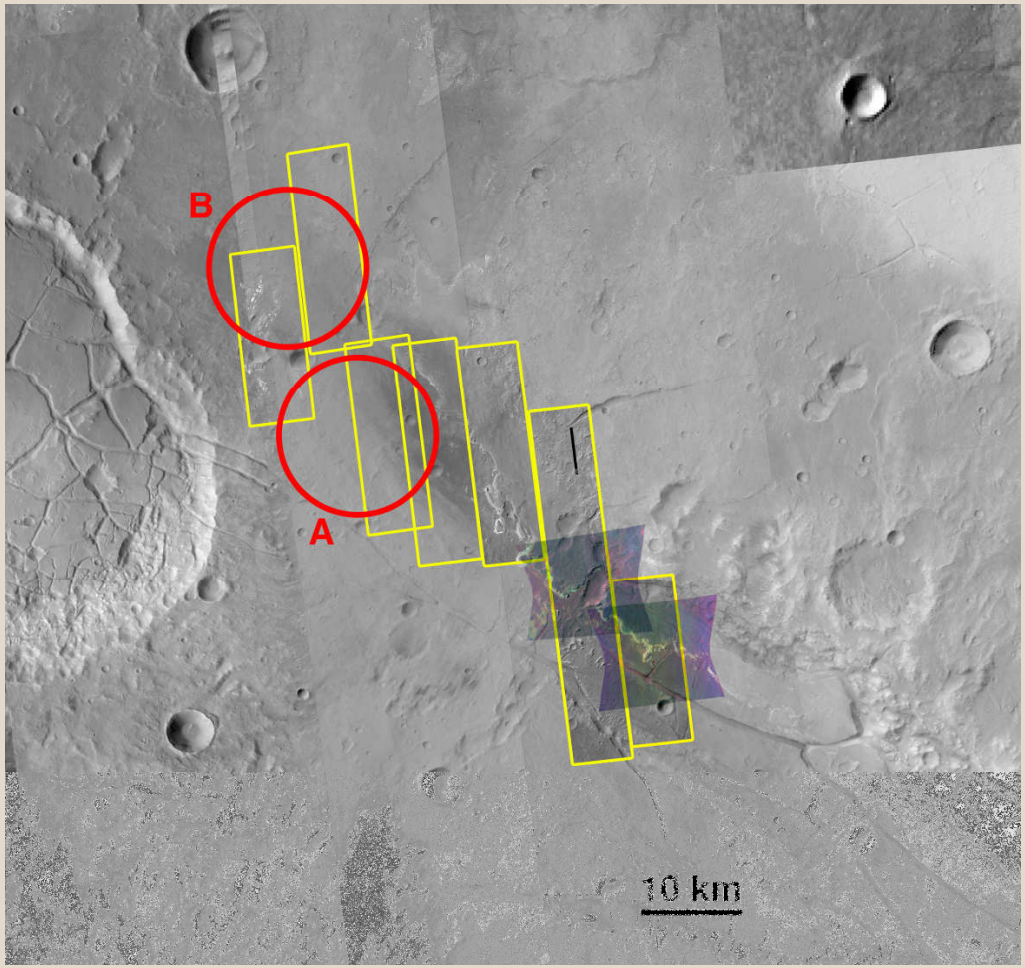
- Clays correspond to layered beds
- Units along valley floor lack hydration feature at 1.9 um but have 2.29-2.31 um absorption
- Small exposures of layered beds seen along the valley floor indicate unit was more extensive in the past

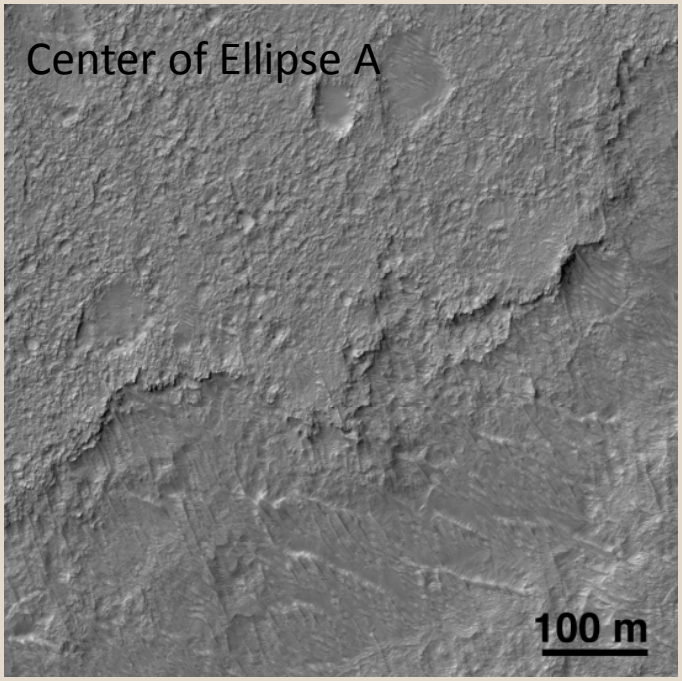


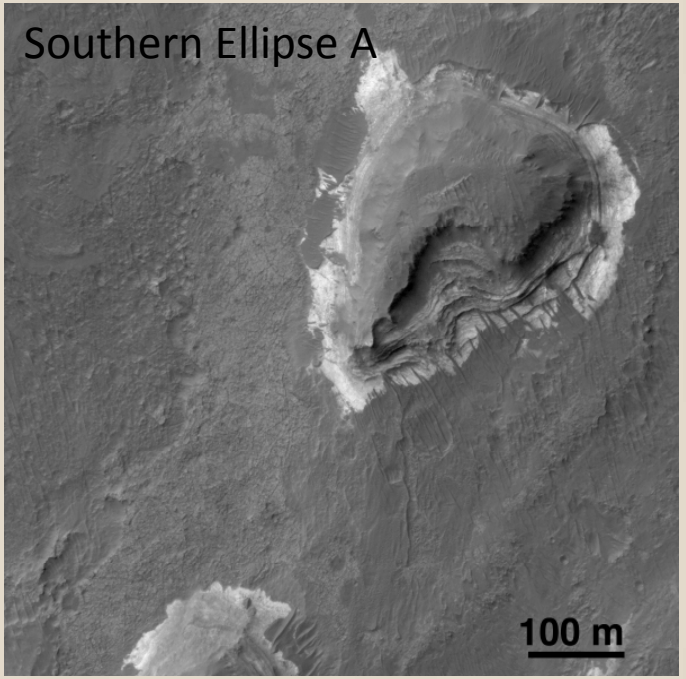


Lower bright beds would be accessible to the rover here, just outside Ellipse A

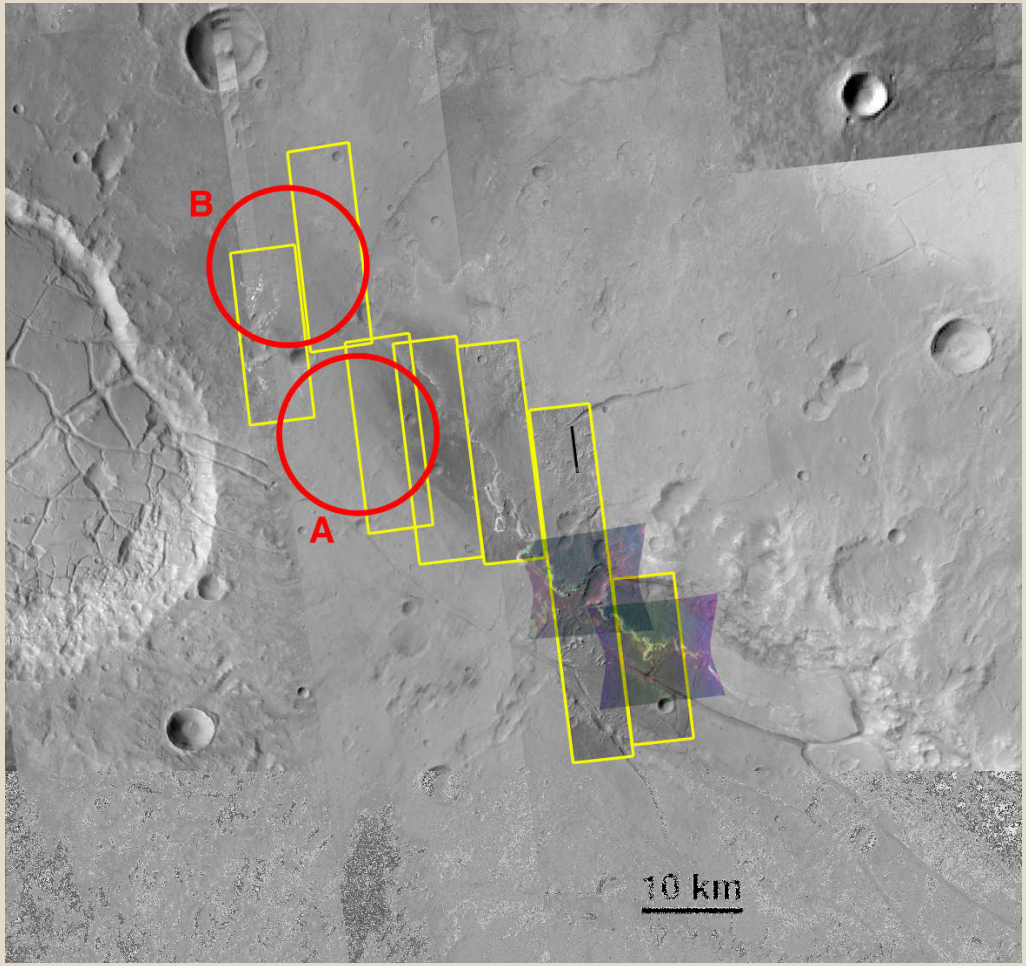
Ellipse A

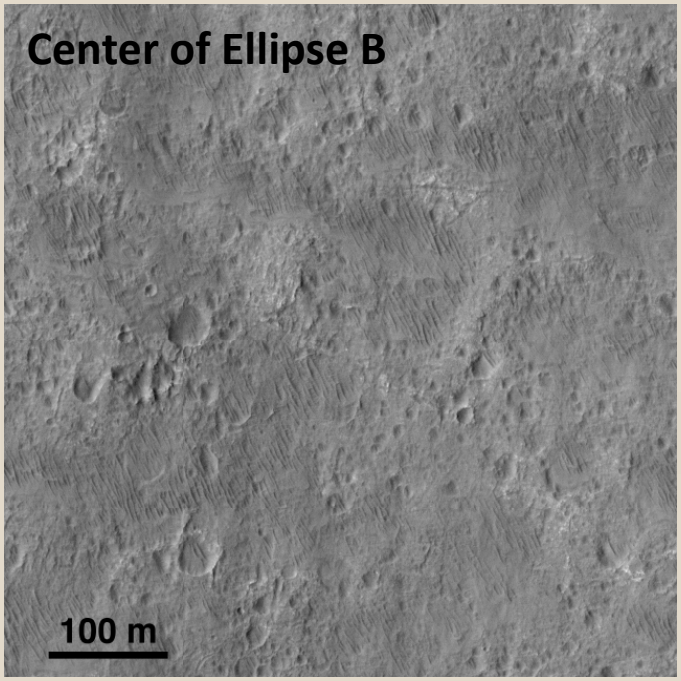


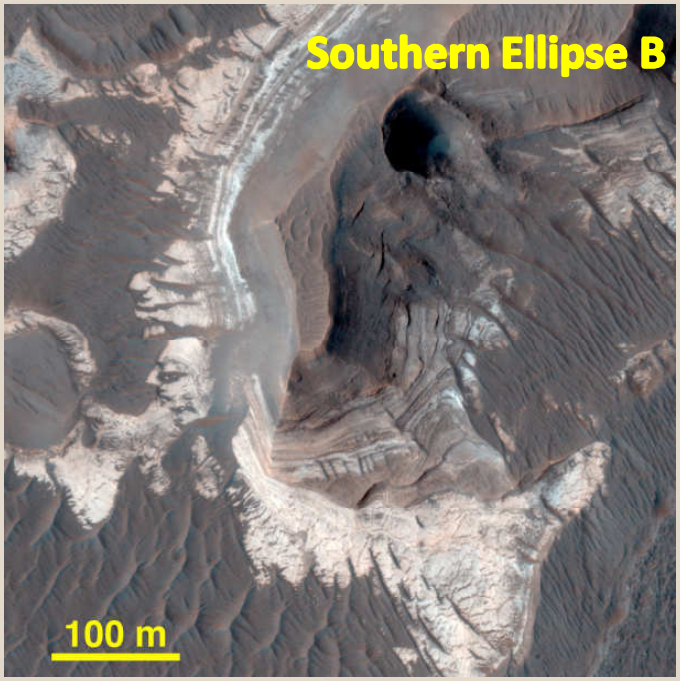




Ellipse B



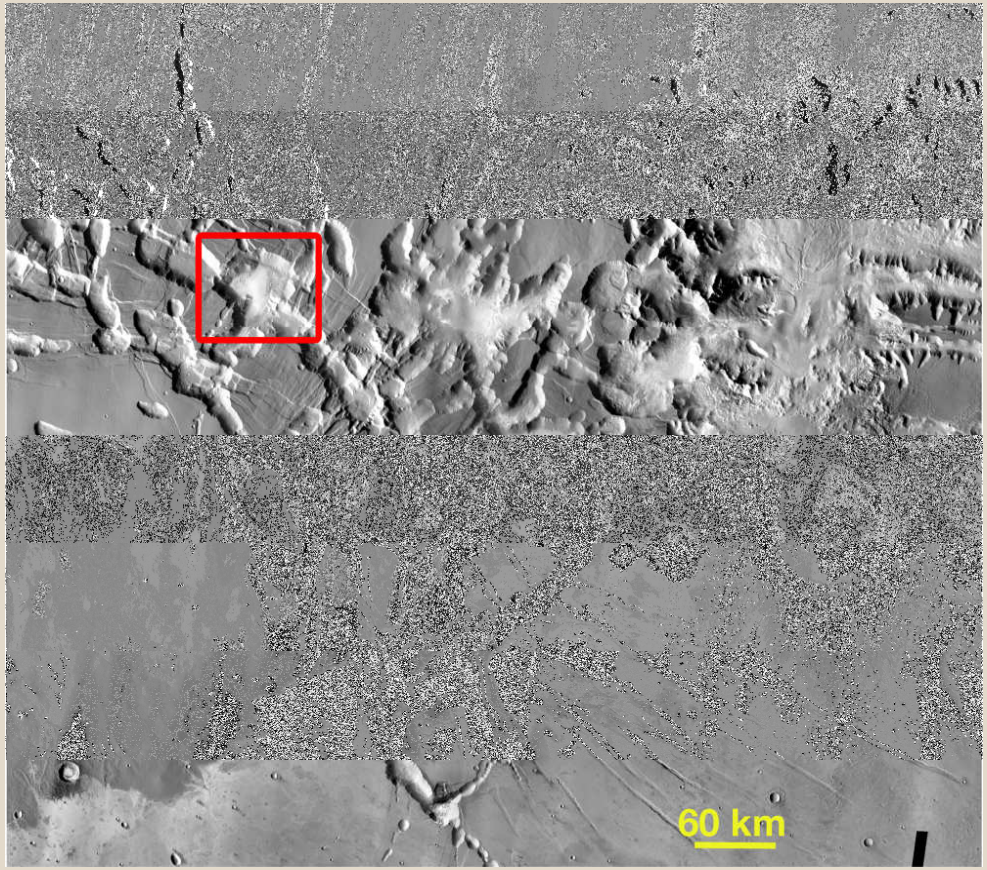




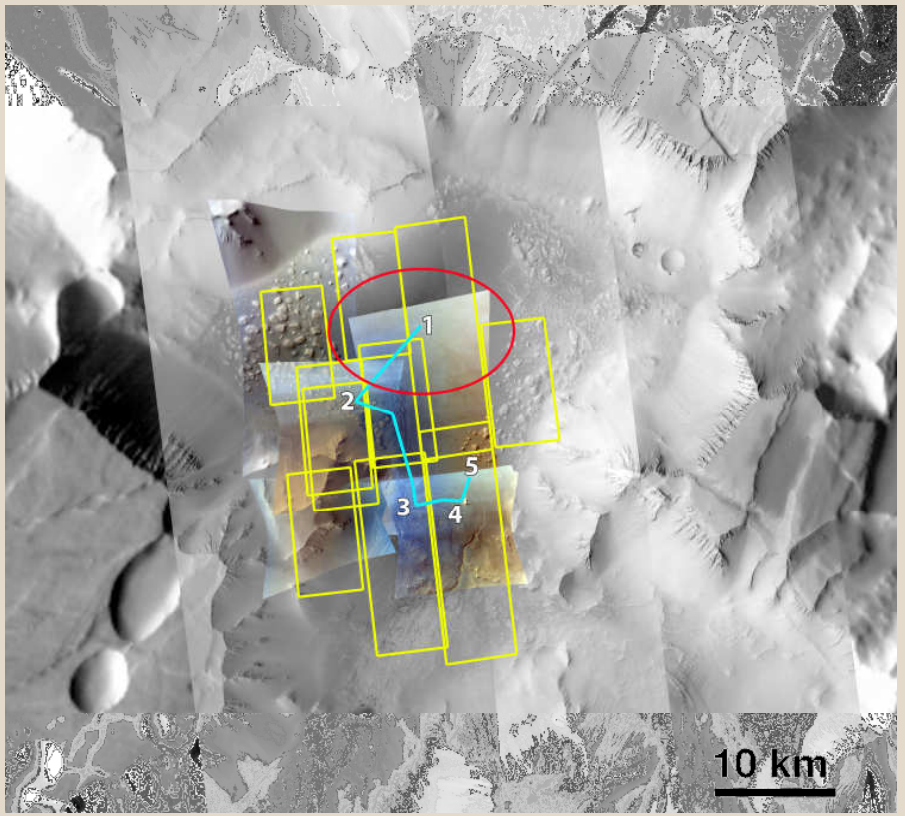
Summary

- In the southern portions of both ellipses are layered sediment presumed to be clays and dehydrated clays.
- To the east of both ellipses are additional exposures of layered sediments.
- Variable morphologies in HiRISE images and mineralogies in CRISM data indicate these sites would enable multiple sediments to be analyzed.
- Clay-mineral bearing strata likely record a wide range of fluvial and lacustrine processes that provide insight into the martian clay cycle.

Noctis Landing Site



THEMIS daytime IR mosaic of Noctis Labyrinthus



15x10 km landing ellipse with proposed rover traverse

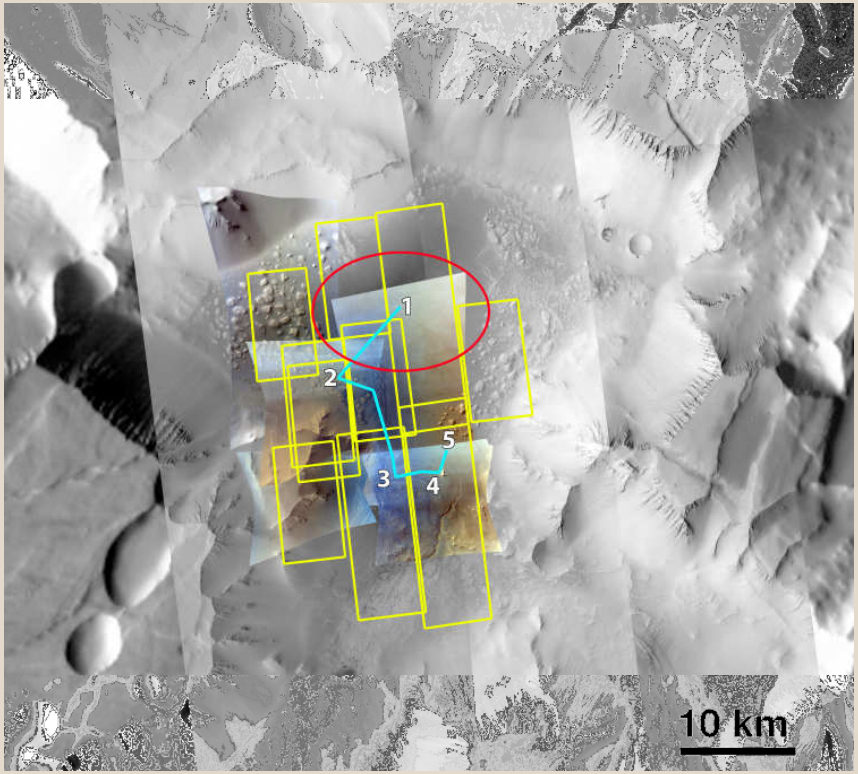
Geologic Setting

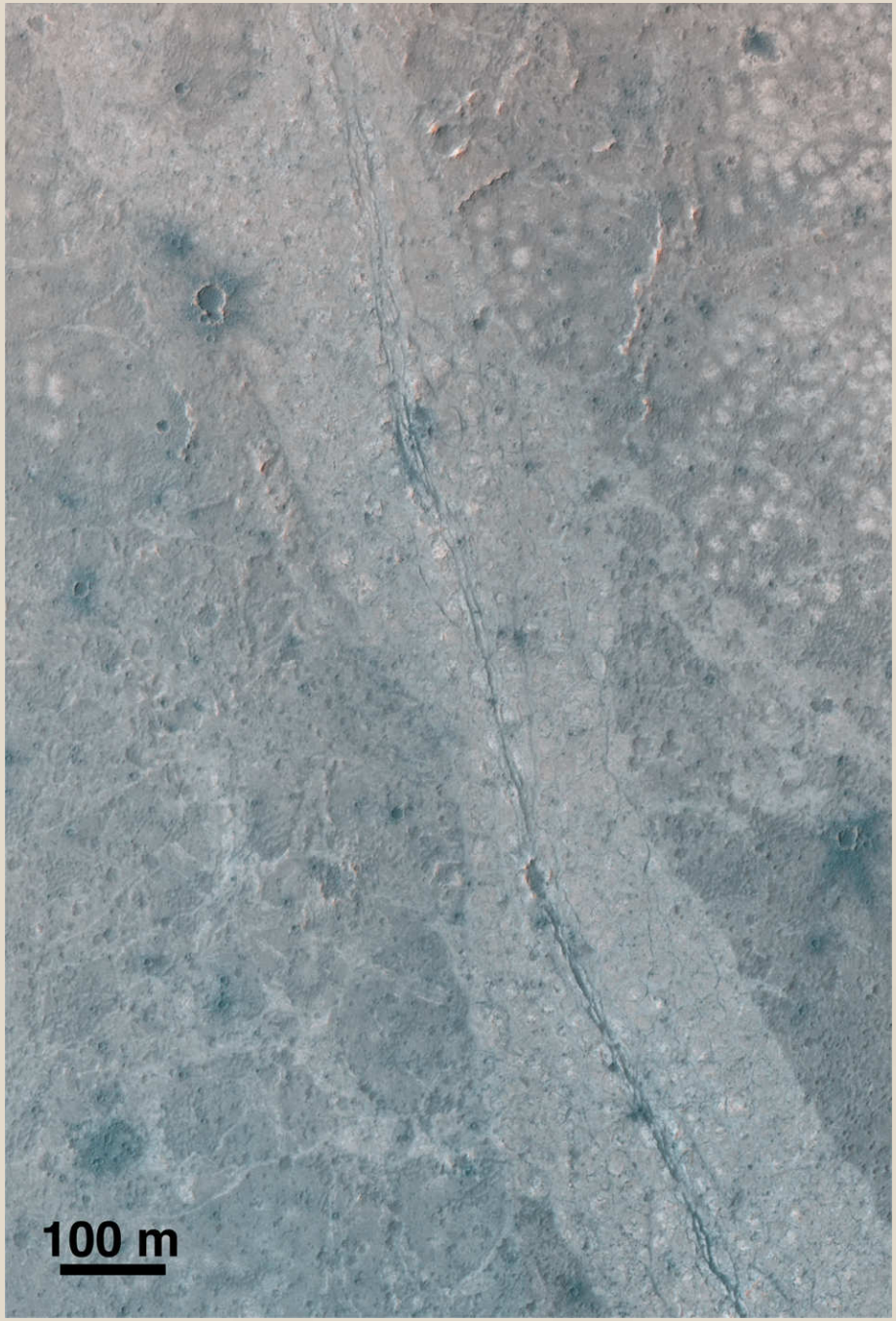
- The landing ellipse has been selected to fit within the smooth plains and avoid mesas closer to the pit walls.
- Previous studies by Mangold et al. [2009] suggest the floor of the trough is covered by 50-100 My old volcanic plains.
- The prime science targets are not within the 15x10 km landing ellipse but rather a few kms southwest of the ellipse and include possible Al-smectites, Ca-sulfates (gypsum or bassanite), and hydrated silica (opal).
- A landing site within this trough could potentially address questions concerning the ages, setting, and formation of clays and sulfates, including the potential habitability of this region in the martian past.

Table 1: Noctis Labyrinthus Landing Site

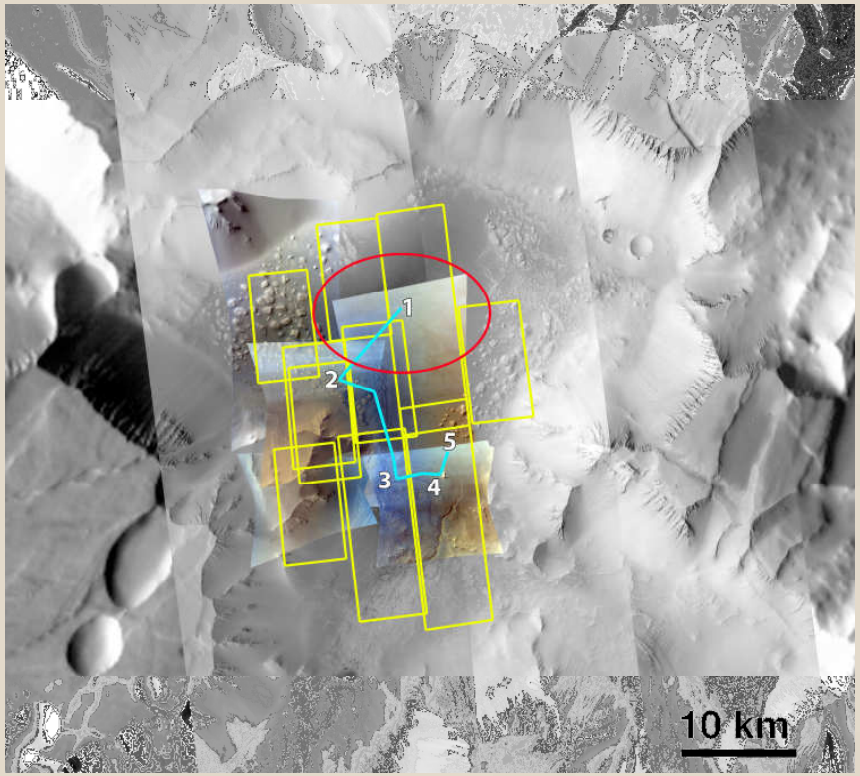
Site Name	Noctis Labyrinthus
Center Coordinates Latitude, longitude	261.03E, -6.86N
Elevation	2.22 km wrt MOLA
Ellipse Size	15 km by 10 km
Prime Science Targets	Smectites, Gypsum, O pal [Highest Priority], Other light-toned units of uncertain composition, valleys, mesas, and Amazonian volcanics [Lower Priority]
Distance of Science Targets from Ellipse Center	Smectites – 8 km to SW Gypsum, Opal – 12 km t o S Valley – 12 km to S

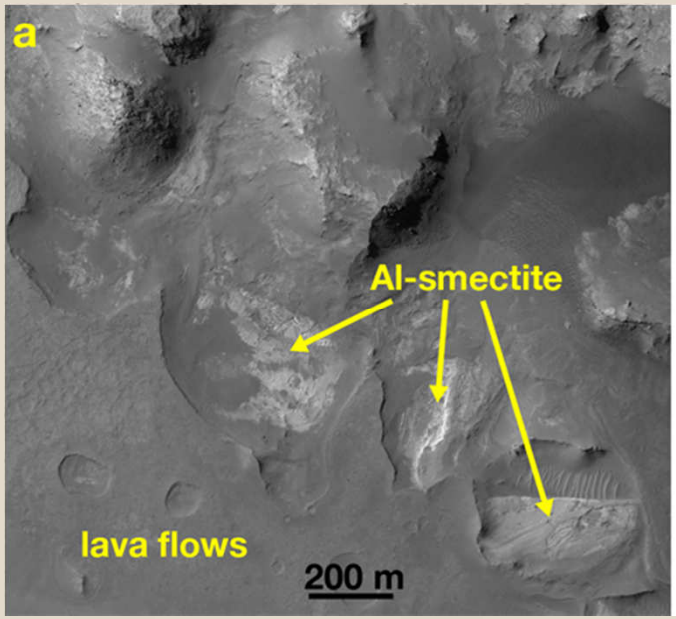
Site 1: Center of Ellipse

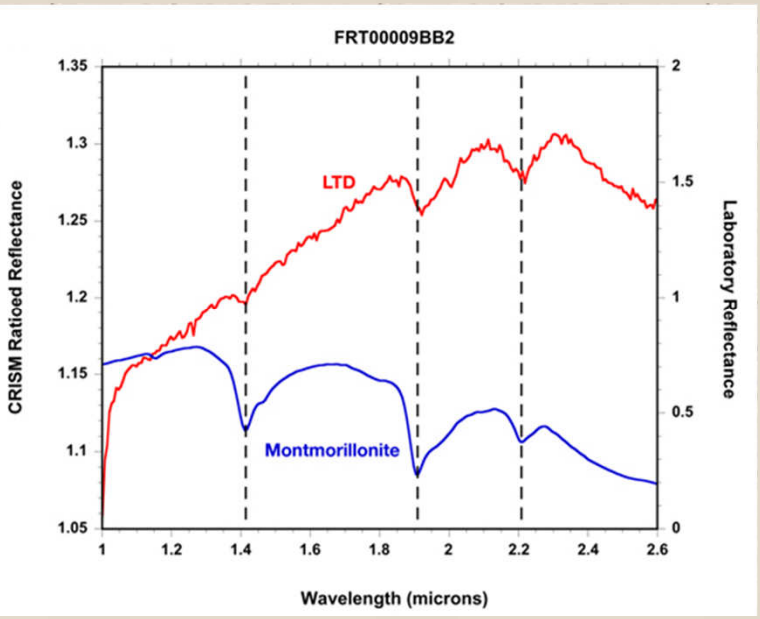


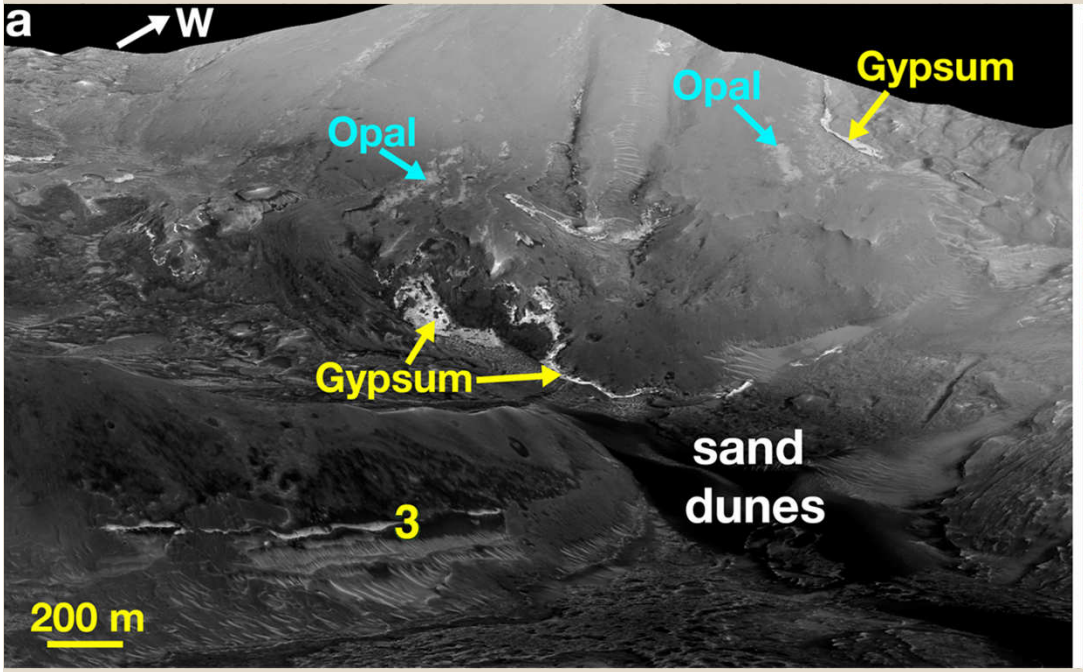


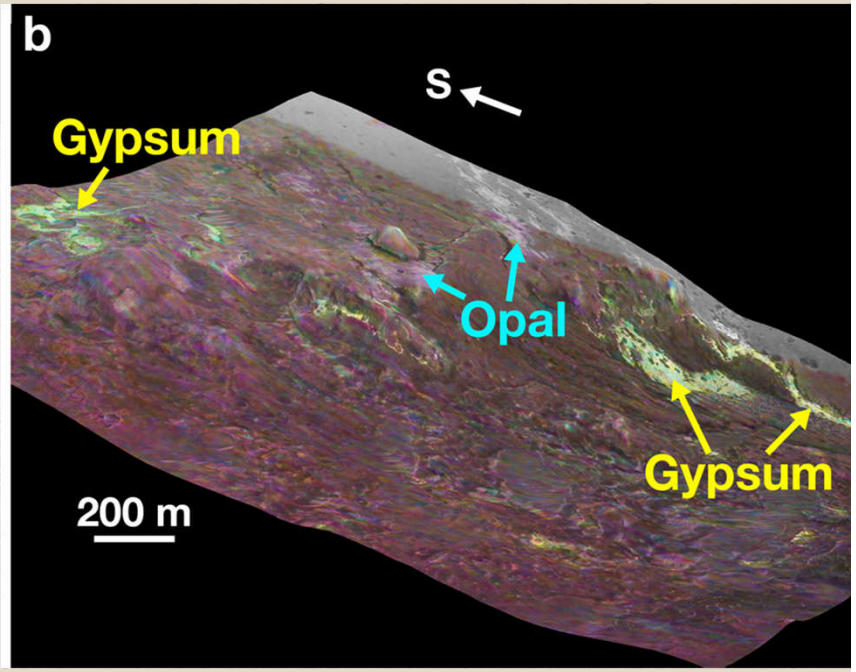
Site 2: Outcrops of clays

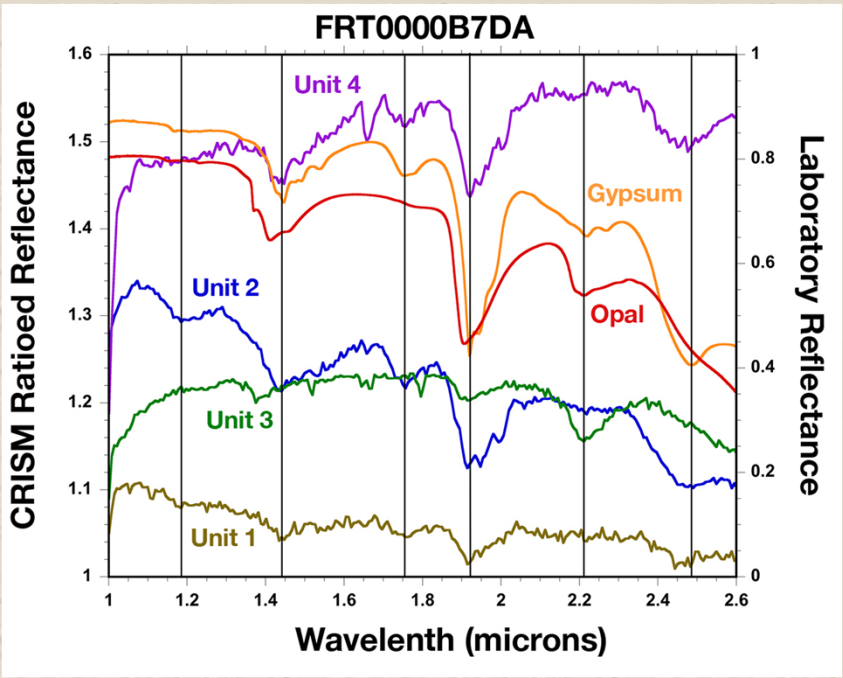






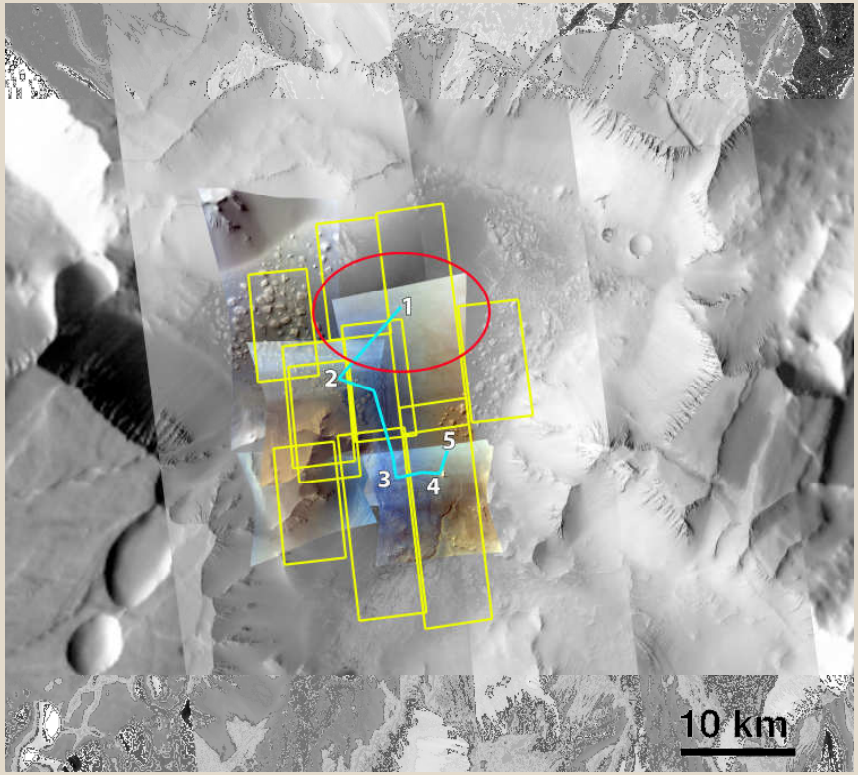






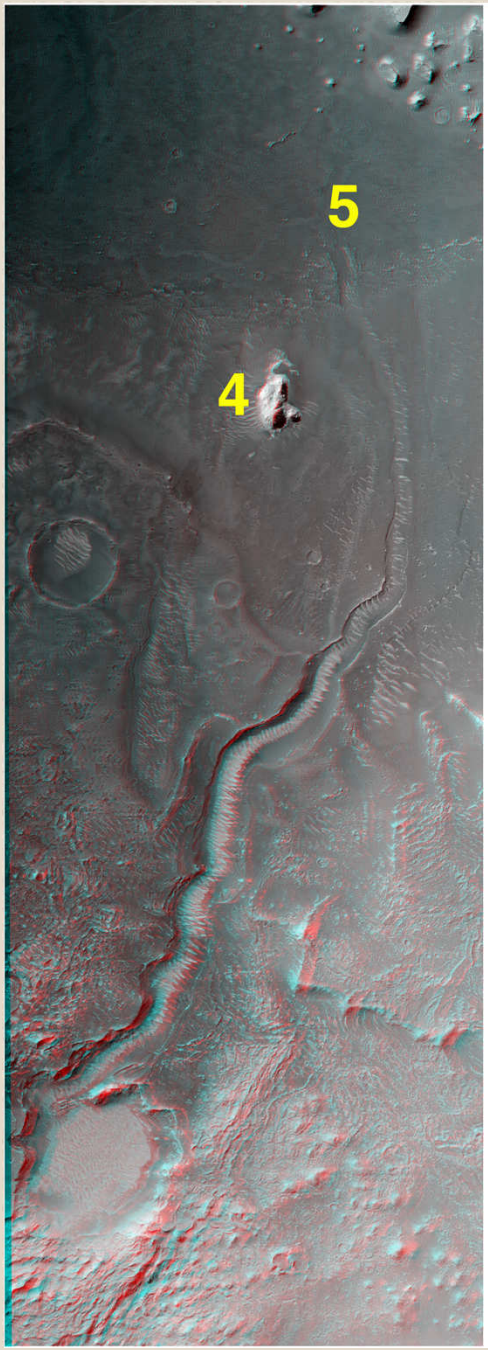
- HiRISE DTM at 7x vertical exaggeration. Location 3 would potentially be accessible to the rover and appears to contain gypsum/bassinite material (Unit 1 in CRISM spectra).
- Unit 2 represents typical gypsum-bearing units.
- Unit 3 was extracted from an opal-bearing unit.
- Unit 4 was taken from the large hill (rover location 4) and appears to contain

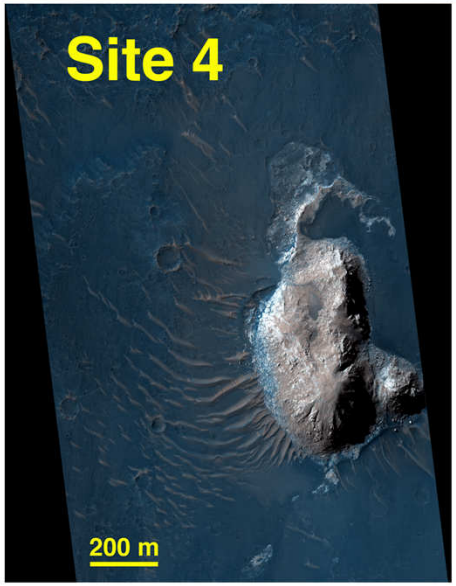
Sites 4,5: Gypsum mound and lava channel

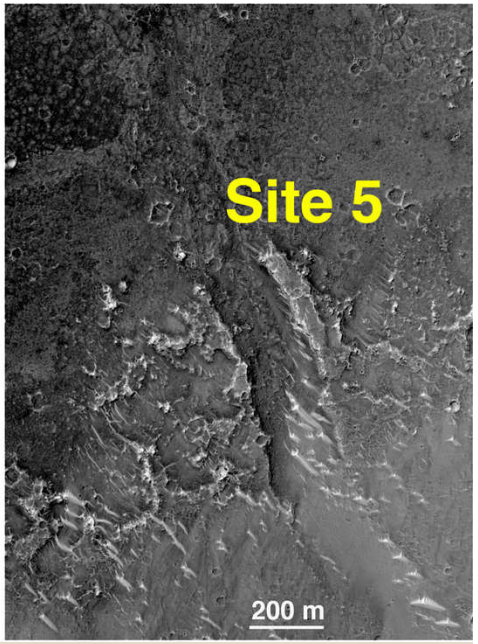


Site 4: CRISM spectra consistent with gypsum/bassanite, making this a desired science target for any rover.

Site 5: Distal end of lava channel where it intersects the trough floor.







Summary of Noctis Site

- Landing ellipse and traverses would enable studies of volcanic and aqueous features.
- Al-rich clays indicate long-duration interaction between water and rock, perhaps in the subsurface.
- Gypsum could have precipitated from low-temperature aqueous fluids, similar to gypsum veins just discovered at Endeavour Crater.
- Opal is consistent with alteration of basaltic lava or ash under low-temperature acidic hydrothermal conditions.

- Thanks to JPL Mars Program for funding support of these two landing site studies!